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SUBJECT: Final Technical Report, Trust Fund Cooperative Agreement #58-6606-4-004 Georgia Commodity Commission for Peaches. "Wheat/Sorghum Rotation: A Nontechnical Management Strategy for the Ring Nematode, *C. xenoplax*"

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1. Name of Performing Organization: USDA, ARS
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2. Trust Fund Cooperative Agreement: #58-6606-4-004.

3. Trust Fund Award Date: 01 June 1994.

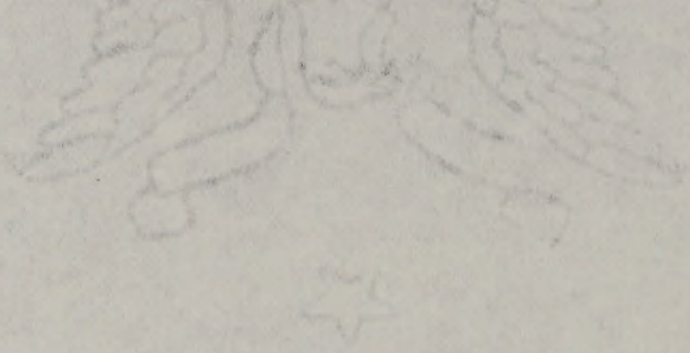
4. Type of Report: Final.

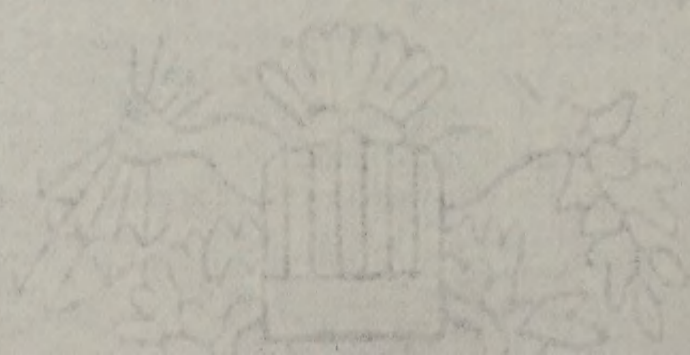
5. Reporting Period: FY95 thru FY99

6. Final Narrative Statement With Results:

The effectiveness of preplant rotation crops and peach rootstocks as alternatives to chemical control of the ring nematode, *Criconemella xenoplax*, were investigated from 1994-present. Results of three independent field experiments follow.

a. **Rotation Study #1** (preplant management strategy) - Results indicate that the population density of ring nematode around peach trees in all rotation treatment plots (previously planted to 1, 2, & 3 years of wheat/sorghum or wheat/fallow) was greater than for trees in soil fumigated with methyl bromide on both sampling dates (Table 1). Secondly, tree death from Peach Tree Short Life (PTSL) was less in methyl bromide fumigated soil after 2 growing seasons. This orchard study was prematurely terminated in October 1996, due to extensive tree death in ALL treatments.





Results are thought to be partially confounded by the flood of 1994, where this area received approximately 19-inches of rain in a 24 hour period. Moreover, these results contradict an earlier field study. It was decided that this experiment should be repeated with several modifications. [See Rotation Study #2 (still in progress) below.]

Table 1. Tree survival and population density of ring nematode on Redhaven/Nemaguard peach in soil previously planted to 1, 2, & 3 years wheat (W)/ sorghum (S) and wheat/fallow (F) and fumigated & nonfumigated soil.

Rotation Sequence	Number of ring nematodes per 100 cm^3 soil		Incidence of PTSL tree death - Oct. 1996 (%)
	Dec. 95	Apr. 95	
Nonfumigated soil	221a**	263a	100a
W-F	315a	177a	100a
W-S	85a	88a	100a
W-F-W-F	293a	108a	100a
W-S-W-S	476a	431a	97a
W-F-W-F-W-F	398a	270a	97a
W-S-W-S-W-S	313a	345a	100a
Fumigated soil	13 b	18 b	64 b

** Numbers within a column followed by the same letter are not significantly different.

b. **Rootstock Resistance Study** (postplant management strategy) - The performance of Guardian rootstock was being compared with Lovell & Nemaguard rootstock in fumigated (methyl bromide) & nonfumigated soil on a PTSL field site. Results indicated that the population density of ring nematode remained lower in fumigated vs. nonfumigated soil for all rootstocks on both sampling dates and that there were no differences in nematode numbers among the 3 rootstocks in the nonfumigated soil (Table 2). Tree mortality data resulting from PTSL was obtained in Oct. 1996 (Table 2). Results *after 2 growing seasons* indicate that trees on Guardian rootstock can succumb to PTSL tree death if not managed properly [such as pruning in December (as these trees were) which is the WRONG TIME OF YEAR TO PRUNE]. However, fewer trees budded to Guardian (67%) rootstock died from PTSL in UNFUMIGATED soil as compared to trees on either Lovell (94%) or Nemaguard (100%) rootstock. Additionally, trees on Guardian (28%) or Lovell (42%) rootstock planted in FUMIGATED soil did not succumb to PTSL tree death as rapidly AFTER 2 YEARS as trees on Nemaguard (64%). Past field studies have shown that Guardian rootstock outlives Lovell over the long-haul. This field study was terminated in October 1996 due to excessive tree loss for the same reasons described above. It was decided that this experiment should be repeated with several modifications. [See Rotation Study #2 (still in progress) below.]

Table 2. Incidence of PTSL on Redhaven peach budded to Guardian™, Lovell, and Nemaguard rootstocks in fumigated and nonfumigated soil.

Rootstock	Fumigation	Number of ring nematodes per 100 cm^3 soil		Incidence of PTSL tree death -Oct. 1996 (%)
		Dec. 95	Apr. 96	
Lovell	No	415a**	178a	94a
Nemaguard	No	221a	263a	100a
Guardian	No	170a	160a	67 b
Nemaguard	Yes	13 b	18 b	64 b
Guardian	Yes	55 b	10 b	28 c
Lovell	Yes	3 b	40 b	42 c

**Numbers within a column followed by the same letter are not significantly different.

c. **Rotation/Rootstock Study #2** (preplant & postplant management strategy) - PHASE 1 *(Establishment of Ground Covers)*: In 1996-97, canola/sorghum (CS3), wheat/sorghum (WS3), fallow/sorghum (FS3) and continuous peach (Goldprince/Nemaguard) plots were established on 1.7 A at the SE Fruit & Tree Nut Research Laboratory in Byron, Georgia. Canola plants were turned under in spring 1997, and not allowed to mature, because we are investigating its potential as a "green manure nematicide" for controlling ring nematode. Wheat on the other hand, was allowed to mature and head out before it was cut down and straw hay removed. Remaining wheat stubble was rotovated under prior to planting sorghum in the respective plots. Sorghum, like wheat, is allowed to mature and head out before it is cut down and removed. Sorghum stubble is rotovated under prior to replanting plots back to canola and wheat. Population dynamics of the ring nematode are being monitored after wheat harvest and again after sorghum harvest. Results to date indicate that ring nematode counts are lower in the 3 grain rotation plots (WS3, CS3, & FS3) as compared to continuous peach (Table 3). The final rotation cycle of canola/sorghum and wheat/sorghum was initiated in fall 1998 and will terminate in fall 1999. (see Phase 2).
PHASE 2 *(Influence of Subsoiling on Ground cover Efficacy)*: This phase will be initiated in fall 1999. During this phase of the study, the influence of rotation treatment (wheat/sorghum, canola/sorghum, & fallow/sorghum) vs. ± subsoiling, vs. rootstock (Nemaguard vs. Guardian), vs. preplant fumigation with methyl bromide will be compared over a 4-year period. The resurgence of ring nematode and incidence of PTSL tree death will be monitored. A preplant rotation recommendation for our growers is expected to result from this research.

Table 3. Population of ring nematode as influenced by different cropping systems

	Sampling Date			
Crop Sequence[a]	June 1997	Sept 1997	June 1998	Oct 1998
WS2	0 a[b]	0 a	9 a	0 a
CS2	0 a	3 a	54 a	3 a
FS2	0 a	12 a	15 a	0 a
Peach	6 b	66 b	312 b	81 b

[a]WS2 = 2-yr. wheat/sorghum; CS2 = 2-yr. canola/sorghum; FS2 = 2-yr. fallow/sorghum; and Peach = 2-yr. continuous peach.
[b]Means within a column followed by the same letter are not different ($P \leq 0.05$) according to LSD.

7. Changes in Approaches:

None in Rotation Study #1 or the Rootstock Study. However, in Rotation/Rootstock Study #2 the following treatments were added - i) canola groundcover, ii) +/- subsoiling, and iii) only evaluating Nemaguard and Guardian rootstocks.

8. Likelihood in Meeting Objectives:

This project has a good chance of meeting its objectives if nothing unexpected happens (i.e., see #9).

9. Unexpected Problems Encountered:

The research plot was exposed to the flood of 1994, where the Central Georgia area received approximately 19-inches of rain in a 24-hour period.

10. Technology Transfer Thus Far:

In Central Georgia and South Carolina, approximately 1,900 acres (27%) of peach land was planted in wheat for nematode control in 1997.

11. Publications:

Nyczepir, A. P., Bertrand, P. F., and Cunfer, B. M. A reduced chemical input cropping system for managing *Criconemella xenoplax* on peach in the southeastern United States. Nematologica 41:327. 1995.

Nyczepir, A. P., T. G. Beckman, and P. F. Bertrand. Evaluation of Guardian™ rootstock as a methyl bromide alternative for managing peach tree short life. Proc. of the Ann. Int'l. Res. Conf. on Methyl Bromide Alternatives and Emissions Reductions, San Diego, CA, Nov. 6-8, 1995, p. 105-1. 1995.

Nyczepir, A. P., Bertrand, P. F., and Cunfer, B. M. Suitability of a wheat-sorghum, double-crop rotation to manage *Criconemella xenoplax* in peach production. Plant Dis. 80:629-632. 1996.

Nyczepir, A. P. Peach tree short life in the United States: An update and advances. Nematropica 26:214-215. 1996.

Nyczepir, A. P., Beckman, T. G., and Reighard, G. L. Research on alternatives to methyl bromide for control of nematode pests on stone fruits. Methyl Bromide Alternatives Newsletter 3 (1):10-11. 1997.

Nyczepir, A. P., D. Ritchie, and R. W. Miller. Nematode control on peaches. Page 21 in: 1999 Southeastern Peach Pest Management and Culture Guide. D. Horton and C. Gorsuch, ed. Univ. Ga. Coop. Ext. Serv. Bull. 1171. 1999.

12. Other Issues:

I want to thank the Georgia Commodity Commission (GACC) for Peaches for funding this project for the last 5 years. The information obtained to date was very beneficial as we continue to develop a nonchemical preplant management strategy for the ring nematode and PTSL disease complex.